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Observations on the food and feeding habits of *Otolithes cuvieri* (Trewavas) off Veraval

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ABSTRACT

Studies on food and feeding habits of *Otolithes cuvieri* based on 1679 specimens showed that it is a carnivorous feeder, subsisting mainly on *Acetes* spp., penaeid prawns, deep-sea prawns, fishes, stomatopods, molluscs, isopods, copepods and fish larvae. All size groups preferred crustaceans. The fishes showed preference for teleost fishes as they grew. The intensity of feeding was higher during the premonsoon and postmonsoon months. Feeding intensity was poor in juveniles and mature fishes.

Introduction

Sciaenids constitute an important fishery along Gujarat coast and form a major constituent of trawl landing at Veraval contributing 12% to the trawl catches. Among sciaenids, *O. cuvieri* is the dominant species forming 48% of the trawl fishery. The information on the food and feeding habits of sciaenids is available in respect of the species such as *Sciaenoids brunneus* (Karandikar and Thakur, 1951), *Otolithes ruber* and *O. argenteus* (Bapat and Bal, 1952), *Protonibea diacanthus* (Rao, 1961), *O. argenteus* (Vaidya, 1960), *Johnius sina* (Nair, 1981), *O. cuvieri* (Chakraborty, 1989) and Hanumanthappa *et al.* (1994). Qasim (1972) critically discussed the dynamics of food and feeding habits of some sciaenid fishes along the Indian coast. More recently, Chakraborty *et al.* (2000) briefly discussed the fishery, biology and stock assessment of Jew fish resources of India. A detailed study on the food

and feeding of *O. cuvieri* has not been carried out at Veraval, except a brief account on the biology by Rao (1985) and hence the present study was undertaken.

Material and methods

Random samples of *O. cuvieri* collected at weekly intervals during October 1993 - September 1996 from the landings by trawlers at Veraval formed the material for the study. The total length and maturity stage of the fish were recorded and the stomach contents analysed. The intensity of feeding was determined based on the degree of distension of the stomach and the amount of food contained in it. The stomachs were classified as gorged, full, $\frac{3}{4}$ full, $\frac{1}{2}$ full, $\frac{1}{4}$ full, trace and empty. The food of the fish was analysed by points volumetric method (Hynes, 1950 and Pillay, 1952). In order to get a better understanding of the intensity of feeding the data for this period was pooled and classified as poorly

fed (empty and trace), moderately fed (1/4 full and 1/2 full) and heavily fed (3/4 full, full and gorged).

Results

Composition of food and seasonal variation

Crustaceans and fishes formed the major part of the diet. Altogether eleven

food elements were noticed in the diet viz., *Acetes* spp., penaeid prawns, fishes, juveniles of squids and cuttlefishes, stomatopods, isopods, deep-sea prawns, crabs and fish larvae. (Table 1). The average contribution of the food elements for the entire period is given in Fig.1.

***Acetes* spp. :** An analysis of the stomach contents of *O.cuvieri* revealed that

TABLE 1. *Monthly percentage composition of different food organisms in the stomach of O.cuvieri at Veraval*

| Name of food items / Months | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sep. |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|---------|------|-------|
| Year : 93-94 | | | | | | | | | | | | |
| <i>Acetes</i> spp. | 58.21 | 62.18 | 68.44 | 38.26 | 30.16 | 32.14 | 43.76 | 42.12 | - | - | - | 44.59 |
| Penaeid prawns | 2.06 | 2.16 | - | - | 28.18 | 20.82 | 30.60 | - | - | No | - | - |
| Fishes | 12.81 | 6.72 | - | - | 12.10 | 14.86 | 3.31 | 23.37 | - | Fishing | - | 34.20 |
| Squids | 2.86 | 4.16 | - | - | 20.82 | 15.12 | 1.02 | 4.26 | - | - | - | 7.34 |
| Cuttlefish | 15.66 | 15.55 | 24.09 | 46.19 | 2.11 | - | - | - | - | - | - | 7.01 |
| Stomatopods | 6.42 | 6.14 | 2.76 | 2.98 | 0.92 | 14.76 | 2.28 | 21.68 | - | - | - | 3.14 |
| Crabs | 1.28 | 1.60 | 1.38 | 5.33 | 2.60 | - | 7.68 | - | - | - | - | 2.17 |
| Deep sea prawns | - | 0.92 | 0.00 | 2.89 | 2.14 | - | 8.62 | 2.68 | - | - | - | 1.57 |
| Isopods | - | - | 0.27 | 2.18 | - | 1.12 | 2.51 | 1.62 | - | - | - | - |
| Copepods | - | 0.57 | 0.21 | 2.17 | - | 0.98 | 0.24 | - | - | - | - | - |
| Fish larvae | 0.87 | - | 2.87 | - | 0.97 | 0.20 | - | 4.26 | - | - | - | - |
| Year : 94-95 | | | | | | | | | | | | |
| <i>Acetes</i> spp. | 42.82 | 28.06 | 46.08 | 61.44 | 12.18 | 28.18 | 54.80 | 40.48 | - | - | - | 56.80 |
| Penaeid prawns | 10.10 | 4.12 | - | - | 35.64 | 18.19 | 4.12 | - | - | - | - | - |
| Fishes | 18.70 | 12.57 | - | - | 21.26 | 22.53 | 3.21 | 23.65 | - | - | - | 14.90 |
| Squids | 1.25 | 2.86 | - | - | 25.47 | 2.15 | 1.05 | 8.86 | - | No | - | 12.00 |
| Cuttlefish | 10.25 | 25.13 | 29.86 | 14.45 | 1.28 | 2.48 | - | - | - | Fishing | - | - |
| Stomatopods | 2.14 | 1.28 | 10.48 | 12.20 | 0.48 | 12.17 | 24.74 | 22.04 | - | - | - | 4.68 |
| Crabs | 12.30 | 16.95 | 0.59 | 1.28 | 2.48 | 1.25 | 6.18 | - | - | - | - | 8.68 |
| Deep sea prawns | - | 1.58 | - | 6.38 | 1.21 | - | 2.59 | 1.27 | - | - | - | 2.81 |
| Isopods | - | - | 2.12 | - | - | 3.28 | 1.28 | 1.58 | - | - | - | - |
| Copepods | - | 7.45 | 8.16 | 4.25 | - | 1.68 | 1.89 | - | - | - | - | - |
| Fish larvae | 2.44 | - | 2.71 | - | - | 8.09 | 0.14 | 2.12 | - | - | - | - |
| Year : 95-96 | | | | | | | | | | | | |
| <i>Acetes</i> spp. | 31.23 | 38.54 | 36.98 | 27.08 | 32.48 | 42.48 | 28.96 | 47.89 | - | - | - | 46.28 |
| Penaeid prawns | 2.11 | 4.14 | - | 35.21 | 18.25 | 9.12 | 7.28 | - | - | - | - | - |
| Fishes | 23.74 | 14.83 | - | - | 28.46 | 22.04 | 35.57 | 31.83 | - | - | - | 22.95 |
| Squids | - | 7.46 | - | - | 7.18 | - | - | 2.69 | - | No | - | 2.16 |
| Cuttlefish | 23.81 | 2.81 | 32.97 | 17.69 | 7.42 | 0.98 | - | - | - | Fishing | - | - |
| Stomatopods | 1.08 | 2.18 | 16.34 | 8.96 | 0.59 | 14.63 | 10.61 | 12.28 | - | - | - | 8.98 |
| Crabs | 15.59 | 21.47 | 1.08 | 1.98 | 2.94 | 1.05 | 4.58 | - | - | - | - | 7.89 |
| Deep sea prawns | - | 7.45 | - | 3.97 | 2.68 | - | 4.59 | 1.28 | - | - | - | 11.74 |
| Isopods | - | - | 2.70 | - | - | 2.28 | 3.78 | 2.78 | - | - | - | - |
| Copepods | - | 1.12 | 7.58 | 5.11 | - | 2.65 | 2.45 | - | - | - | - | - |
| Fish larvae | 2.44 | - | 2.35 | - | - | 4.77 | 2.18 | 1.25 | - | - | - | - |

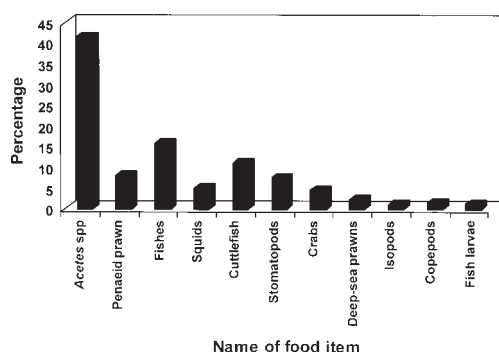


Fig. 1. Annual average food composition of *O. cuvieri* during 1993-96

Acetes spp. formed the chief item of food in all months. *Acetes indicus* was the main food item in the gut throughout the period (41.80 %).

Fishes : Fishes formed another important food item of *O. cuvieri* in almost all the months. Among fishes the following species could be identified: *Bregmaceros maccllellandi*, *Polynemus* spp., *Megalaspis cordyla*, *Trypauchen vagina*, *Stolephorus* spp., *Coilia dussumieri*, *Nemipterus japonicus*, *N. mesoprion*, *Cynoglossus* spp. and ribbon fishes. The annual average contribution of fishes was 15.83 %

Molluscs : Squids and cuttlefishes represented molluscan component in the food. Squids were found in the stomach during some months. Their abundance was more during February-May and September – November and represented by *Loligo duvacelli*. The average contribution of squid was 4.77 %. The cuttlefish represented by *Sepia pharaonis* contributed 10.36 % and was found during September-March.

Penaeid prawns: Penaeid prawns were the second major food element present in the stomach. They were represented by species like *Metapenaeus affinis*, *M. brevicornis* and *Parapenaeopsis stylifera*. Penaeid prawns were present in the

stomach during October- November and February-April. The average contribution of penaeid prawns was 8.58 % with the monthly variations ranging from 2.06 % to 35.64 %.

Stomatopods : Stomatopods were present in the stomach during almost all the months mostly in the young fishes with the average composition of 7.55 % and the main species was *Oratosquilla nepa*.

Deep-sea prawns : Two species of non-penaeid prawns such as *Solenocera crassicornis* and *S. chopri* were found during January-February, April-May, September and November. On an average they formed 2.41 %.

Crabs : Small sized crabs represented by species like *Thalassoma* spp. were present during April and September to November and the average contribution was 4.63 %.

Copepods : Copepods represented by *Acrocalanus* spp., *Calocalanus* spp., *Labidocera* spp. and the *Euterpina* spp. were present in the stomach during November-April and on an average they formed 1.59 %.

Others: Isopods and fish larvae were the other food items and the average contributions of these items were 1.08% and 1.26% respectively. The isopods were present mainly during December-January and April-May months while the fish larvae of carangids, threadfin breams and eels were dominant and occupied the last place.

Food in relation to length

The importance of different food items in relation to length was studied (Table 2). *Acetes indicus* was preferred by all the size groups. Teleost fishes were present in the stomach of fish of 150mm size and above. The presence of fishes in

the stomach found to be increasing with the size of the fish. The occurrence of penaeid prawns was observed as the fish grew beyond 180mm and its percentage also increased with the size of the fish.

93-94 to 95-96 are given in Table 3. Fishes with empty stomach and trace stomach were observed during most of the months and average contribution of fishes with empty stomach and trace

TABLE 2. Average percentage composition to *O.cuvieri* in relation to different size groups during 1993-96

| Size groups (mm)/Food items | Acetes spp. | Penaeid prawns | Fishes | Squids | Cuttle-fishes | Stomato-pods | Crabs | Deep sea prawns | Isopods | Cope pods | Fish larvae |
|-----------------------------|-------------|----------------|--------|--------|---------------|--------------|-------|-----------------|---------|-----------|-------------|
| 80-99 | 24.40 | - | - | 1.50 | 14.77 | 25.00 | 11.31 | 7.87 | 2.11 | 7.14 | 5.90 |
| 100-119 | 49.56 | - | - | 2.21 | - | 13.85 | 12.51 | 8.71 | 3.82 | 7.02 | 2.34 |
| 120-139 | 37.47 | - | - | - | 5.00 | 22.15 | 17.66 | 5.66 | 1.51 | 5.63 | 4.92 |
| 140-159 | 46.39 | - | 6.30 | 10.84 | - | 16.05 | 5.45 | 8.66 | 0.79 | 2.45 | 3.07 |
| 160-179 | 46.72 | - | 9.14 | 6.95 | 15.69 | 11.30 | - | 2.07 | 6.96 | - | 1.18 |
| 180-199 | 54.89 | 6.93 | 12.97 | 8.65 | 6.31 | 9.41 | - | 0.84 | - | - | - |
| 200-219 | 56.21 | - | 35.15 | - | 8.64 | - | - | - | - | - | - |
| 220-239 | 56.21 | - | 35.15 | - | 8.64 | - | - | - | - | - | - |
| 240-259 | 54.79 | 13.26 | 24.72 | - | - | - | 7.23 | - | - | - | - |
| 260-279 | 25.87 | 29.68 | 28.87 | 5.01 | 10.58 | - | - | - | - | - | - |
| 280-299 | 44.22 | 15.17 | 12.74 | 19.16 | 6.71 | - | 2.01 | - | - | - | - |
| 300-319 | 33.21 | 16.25 | 16.86 | 11.95 | 17.43 | - | 4.31 | - | - | - | - |
| 320-339 | 33.35 | 18.86 | 29.98 | - | 17.82 | - | - | - | - | - | - |
| 340-359 | 19.01 | 12.37 | 9.77 | 3.13 | 43.31 | 7.93 | 4.50 | - | - | - | - |

Juveniles of crabs were observed mostly in the stomach of the young ones and occasionally in the large fishes. Fishes of all size groups preferred the juveniles of molluscs in small percentage. Stomatopods and juveniles of deep-sea prawns were observed in the young fishes but rarely in the adult fishes. Fish larvae, isopods and copepods were observed only in the stomach of fishes below the size of 180mm.

Feeding intensity

Percentage occurrence of different degrees of fullness of stomach in different months during the year

stomach for the period was 53.34 % and 6.34 % respectively (Fig.2). Occurrence of fishes with 1/4 full stomach, 1/2 full stomach and 3/4 full stomach showed more or less similar fluctuation during the period. Presence of fishes with full and gorged

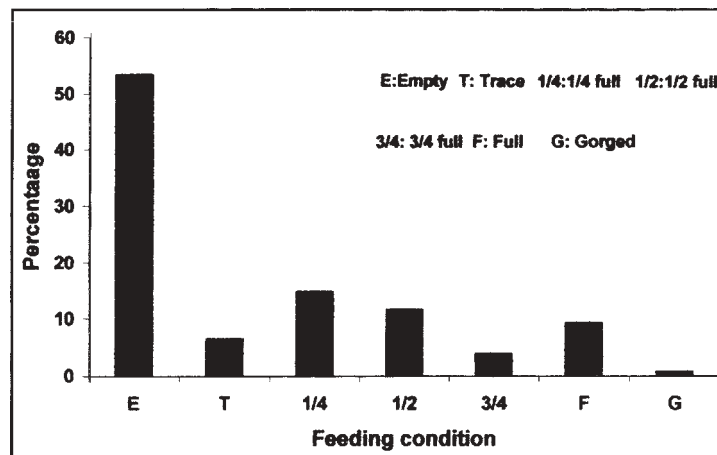


Fig. 2. Average annual feeding condition of *O. cuvieri* at Veraval

TABLE 3. Percentage occurrence of different intensities of feeding in *O. cuvieri* in relation to months

| Months | No. of specimens examined | Empty | Trace | 1/4 full | 1/2 full | 3/4 full | Full | Gorged |
|---------------------|---------------------------|------------|-------|----------|----------|----------|-------|--------|
| Year : 93-94 | | | | | | | | |
| October | 65 | 18.46 | - | 26.15 | 35.38 | 1.54 | 10.77 | 7.69 |
| November | 48 | 45.42 | - | 20.83 | 23.33 | 2.08 | 8.33 | - |
| December | 73 | 57.53 | - | 21.03 | 12.33 | 5.00 | 4.11 | - |
| January | 55 | 65.45 | - | 20.00 | - | 12.73 | 1.82 | - |
| February | 86 | 70.93 | 4.65 | 6.98 | 4.65 | - | 12.79 | - |
| March | 46 | 97.83 | - | - | - | - | 2.17 | - |
| April | 66 | 68.18 | 12.12 | - | 16.67 | 1.52 | 1.52 | - |
| May | 41 | 29.27 | - | 7.32 | 29.27 | 12.20 | 21.95 | - |
| June | - | - | - | - | - | - | - | - |
| July | - | No fishing | - | - | - | - | - | - |
| August | - | - | - | - | - | - | - | - |
| September | 29 | 58.62 | 13.79 | 10.34 | - | - | 17.24 | - |
| Year : 94-95 | | | | | | | | |
| October | 58 | 37.07 | - | 16.72 | 18.62 | 3.45 | 24.14 | - |
| November | 62 | 19.35 | - | 12.90 | 25.81 | 9.68 | 32.26 | - |
| December | 63 | 47.14 | - | 15.87 | 19.52 | 7.94 | 9.52 | - |
| January | 76 | 67.11 | - | 13.15 | 13.16 | 2.63 | 3.95 | - |
| February | 77 | 71.43 | - | 5.19 | 7.79 | - | 15.58 | - |
| March | 55 | 69.45 | - | 10.55 | 5.45 | - | 14.55 | - |
| April | 68 | 58.82 | 4.41 | 10.29 | 19.12 | - | 4.41 | 2.94 |
| May | 65 | 35.38 | 6.15 | 10.78 | 27.69 | 9.23 | 7.69 | 3.08 |
| June | - | - | - | - | - | - | - | - |
| July | - | No fishing | - | - | - | - | - | - |
| August | - | - | - | - | - | - | - | - |
| September | 41 | 29.27 | 4.88 | 17.07 | 19.51 | 9.76 | 17.07 | 2.44 |
| Year : 95-96 | | | | | | | | |
| October | 67 | 35.30 | 11.94 | 26.87 | 8.96 | 10.45 | 6.49 | - |
| November | 81 | 42.96 | 12.35 | 26.18 | 12.35 | 1.23 | 3.70 | 1.23 |
| December | 62 | 36.94 | 11.29 | 29.03 | 9.84 | 4.84 | 8.06 | - |
| January | 67 | 46.19 | 19.40 | 28.44 | 0.00 | 5.97 | - | - |
| February | 85 | 60.00 | 11.76 | 21.18 | - | - | 7.06 | - |
| March | 77 | 55.45 | 10.39 | 25.06 | - | 2.60 | 6.49 | - |
| April | 53 | 52.83 | 11.33 | 15.09 | 15.09 | - | 5.66 | - |
| May | 67 | 45.37 | 13.44 | 17.31 | 11.94 | 4.48 | 7.46 | - |
| June | - | - | - | - | - | - | - | - |
| July | - | No fishing | - | - | - | - | - | - |
| August | - | - | - | - | - | - | - | - |
| September | 47 | 57.45 | 25.53 | - | - | 17.02 | - | - |

stomachs were observed during September-November and May, indicating that the feeding intensity was higher during premonsoon and post monsoon months. Poorly fed fishes dominated in all the months except in October. Moderately

fed and heavily fed fishes had higher occurrence during September-November and April-May (Fig.3).

Feeding in relation to maturity

The feeding condition of juveniles,

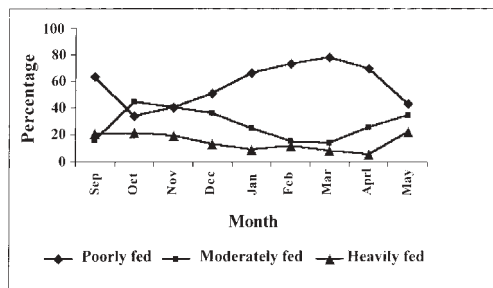


Fig. 3. Average monthly feeding condition of *O. cuvieri* at Veraval during 1993-96

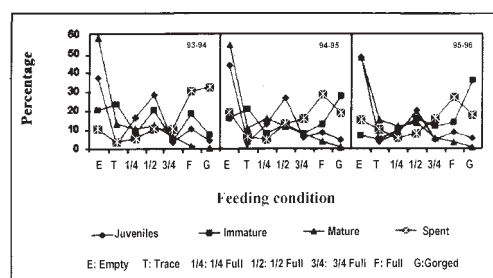


Fig. 4. Feeding intensity of *O. cuvieri* in relation to different stages of maturity

immature, mature and spent fish is given in Fig.4. The feeding intensity was found to be more in immature and spent fishes and poor in mature and juveniles throughout the study period.

Discussion

O. cuvieri is a carnivore feeding on a mixed diet consisting of crustaceans and teleost fishes. Among the crustaceans, prawns and crabs formed the principal diet. *Acetes indicus* was the main crustacean component found in the stomach throughout the year. The penaeid prawns that formed the food were *P. stylifera*, *M. affinis* and *P. indicus*. The presence of crab was found only in the young fishes. As the fish grows, it slowly becomes more active feeder, feeding mainly on large invertebrates and fishes. The absence of planktonic organisms in the food of adults in contrast to the young ones is due to the different habitat of fish (Qasim, 1972).

Rao (1985) observed that prawns followed by teleosts formed major food component of *O. cuvieri* along the Saurashtra coast. Prawn landings by trawlers are highest along the Suarashtra coast with peak during April-May and September-October (Kagwade, 1967), and *Acetes indicus* is a dominant species making it one of the main components of the food item.

Suseelan and Nair (1969) found that prawn and teleosts, besides a wide variety of organisms like stomatopods, amphipods, isopods, copepods, and salpa were also present in the stomach of *O. ruber*. Jacob (1948) and Chacko (1949) observed that *O. ruber* is piscivorous, feeding on fishes with the help of cuspicious canines. Bapat and Bal (1952) noticed plankton-feeding habit in juveniles of *O. argenteus* and a distinct carnivorous habit as well, feeding mainly on fishes. Vaidya (1960) recorded the adult to be a carnivore feeding on crustaceans, teleosts and cephalopods and the post larvae and the juveniles as surface feeders feeding chiefly on crustaceans. Rao (1961) stated that the juveniles of '*Ghol*' *Protonibea diacanthus* like 'koth' showed a predominance of prawn in their diet. Karandikar and Thakur (1951) observed that sciaenids are carnivores and feed on fishes, crustaceans, molluscs and annelids. The present study showed that fish become more ichthyophagous with age and a number of fishes hitherto not recorded have been observed.

From the above, it is clear that the sciaenids exhibit a general uniformity of habits and are carnivorous showing primary preference to crustacean diet, especially in the juvenile stage. With the increase in their length they gradually supplement it with fish.

O. cuvieri, like other sciaenids prefers crustaceans, especially *Acetes indicus* as

their primary food, feeding throughout the year. Fish forms a secondary food item, while molluscs are taken in occasionally. The percentage of variation of food is more evident according to the size of the fish and season.

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